

Industrial Entomology

Lac culture

The commercial cultivation of lac insects is known as lac culture.

Species

4 species of lac insects are-

1. *Kerria lacca*.
2. *Tachardia signoret*.
3. *Tachardiella cockrell*.
4. *Tachardina cockrell*.

Kerria lacca is available in Bangladesh.

Types

Depending on the cultivation procedure, lac insect are two types-

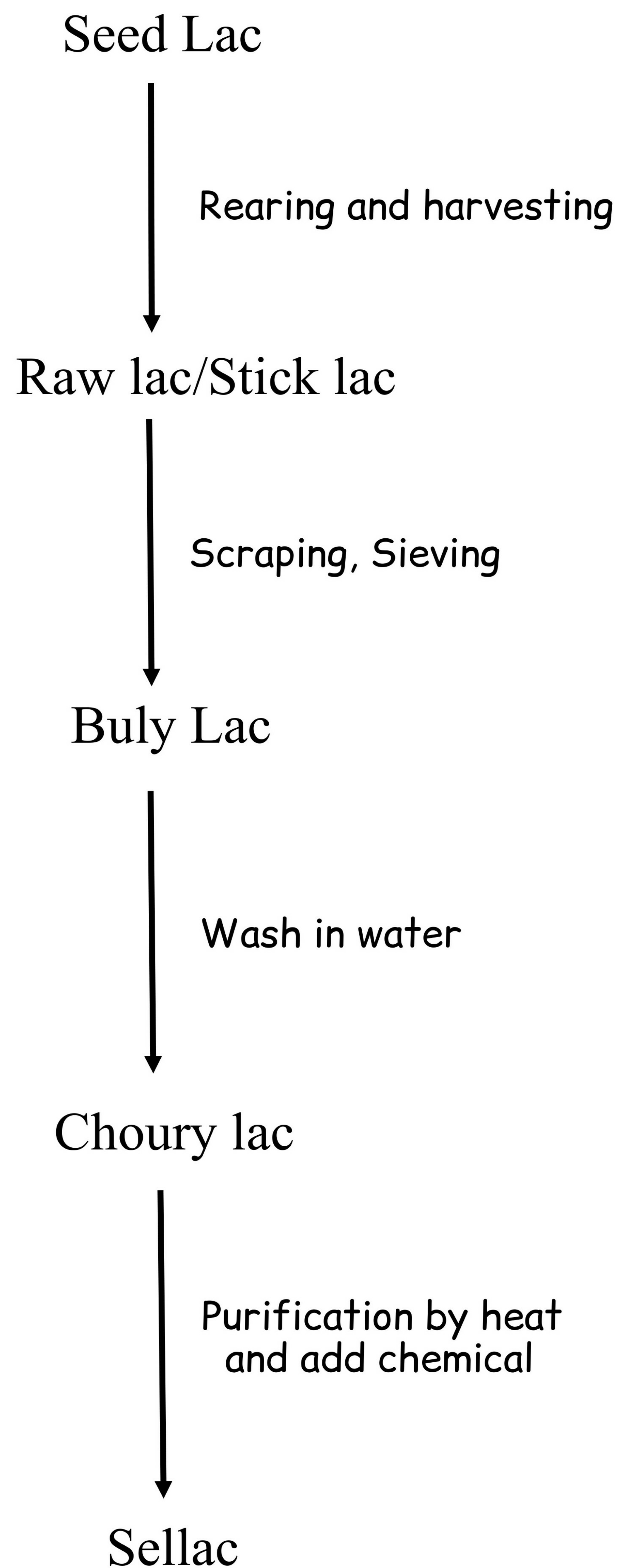
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| 1. Kusumi (2 types)- | 2. Ranginee (2 types)- |
| a) Aghani. | a) Katki. |
| b) Juhi. | b) Baishaki. |

Ranginee is available in Bangladesh and Kusumi practiced in India.

Host Plant

- a) Jujube/ber.
- b) Kusum.
- c) Polash.
- d) Acacia.
- e) Fig etc.

Lac production Technology



Seed lac: Lac insect are borne in plant, specially on the growing point of the plant. The twig which we select for seed lac must be 15-30 cm in length and most of the lac insect remain in egg stage.

Raw lack/Sticky lac: After preparation of seed lac, it will be attached with the growing point of the host plant. Seed lac is kept in this condition for about two weeks. By this time, the egg will hatch and migrate to the host plant. When the lac insect spread all over the host plant, the

seed lac is to removed from the host plant. Lac insects have piercing sucking type mouthparts. They will suck cell sap from the host plant by this time they attain nymphal period and secret resin from their formal gland. A layer of resin about 0.6-1.3 cm built in the host plant. The twig of the host plant with resin is cut and collect lac from them. This is called raw/stick lac.

Buly lac: From raw lac or stick lac, we get buly lac through scraping and Sieving. The buly lac is washed with water for several times.

Choury lac: After washing of buly lac, the lac which we get is called choury lac.

Shellac: Afterword purification may be done or may not be done. If purification is done, heat is applied for boil and then the lac is kept in different shape container giving in different shape. After this process the lac which we obtain is called shellac.

Prospect of Lac culture in Bangladesh

In Bangladesh seed lac are grown two different times. One time is June–July and harvesting period in the month of October–November. Another time is October–November and harvesting in the month of June–July.

To obtain more amount of lac, twig is needed and for this season host plant is to be pruned for two times.

▲ February–March.

▲ May–June.

Immediate after pruning, nitrogenous fertilizer have to be applied around the host plant which will make the host plant succulent and this is suitable for lac insect to suck.

Uses of Shellac

▲ It was used in ancient time as wood finish, skin cosmetic and dye for wool and silk.

▲ Lac for dye has been somewhat replaced by the emergence of synthetic dyes though it remains in use, and some juices, carbonated drinks, wine, jam, sauce, and candy are coloured using it.

▲ Lac is used in folk medicine as a hepatoprotective and anti-obesity drug.

▲ It is used in violin and other varnish and is soluble in alcohol.

▲ Nail polish, lipstick, gala, Jewellery shop, toys etc are prepared from lac.

Sericulture

The culture of silkworm moth for commercially silk purpose is known as sericulture. It include both rearing of silkworm and moriculture (mulberry culture).

Types of Silkworm

1. Mulberry silkworm: *Bombyx mori*.

2. Eri Silkworm: *Philosamia Cynthia*.

3. Tasar silkworm

- ◆ Indian tasar: *Antheraea mylitta*.
- ◆ Chinese tasar: *Antheraea pernyi*.
- ◆ Japanese tasar: *Antheraea yamamai*.

4. Muga silkworm: *Antheraea assamensis*.

Beside these, there is a special type of silkworm known as Fish line silkworm: *Eriogyra pyretorus*.

Food plants for silkworm

1. Mulberry silkworm: Mulberry plants.

2. Eri silkworm: Castor leaves.

Besides, Cassava, Papaya, Sweet potato, Champa etc.

3. Tasar silkworm

- ◆ Indian tasar: Asam, Arjun.
- ◆ Chinese/Japanese tasar: Oak leaves.

4. Muga silkworm: Leaves of som and soalu.

5. Fish line silkworm: *Liquidambar formosana*.(Growing in Hawaii Island)

Difference between Mulberry and Eri silkworm

Mulberry silkworm	Eri silkworm
1. Thread continuous.	1. Thread discontinuous.
2. Fine silk.	2. Coarse silk.
3. Small cocoon size.	3. Large cocoon size.
4. Comparatively low product.	4. High product.

Classification of mulberry silkworm

Mulberry silkworm is classified may various ways-

▲ On the basis of **origin or regional distribution**

1. European silkworm.
2. Japanese silkworm.
3. Chinese silkworm.
4. Indian silkworm.

▲ On the basis of **generation per year**

1. Univoltine: This type of silkworm produce one generation per year.
2. Biovoltine: This produce two generation per year.
3. Multivoltine: In this case more than two (5-8) generation produce per year.

▲ On the basis of **larval moult**

1. Tri-moulters.
2. Tetra-moulters (In Bangladesh).
3. Penta-moulters.

▲ On the basis of **strains**

1. Pure strains.
2. Hybrid strains.
 - a. Monohybrid: When two strains are involved.
 - b. Polyhybrid: When more than two strains are involved.

Races of Silkworm

- a) Nistari: C/40.
- b) Nistari: Nawabganj.
- c) Nistari: Mirganj.
- d) Nistari: Chandraghona.
- e) Nistid: White.
- f) Nistid: Sylhet.

Sketch the outline of Life Cycle of Mulberry silkworm

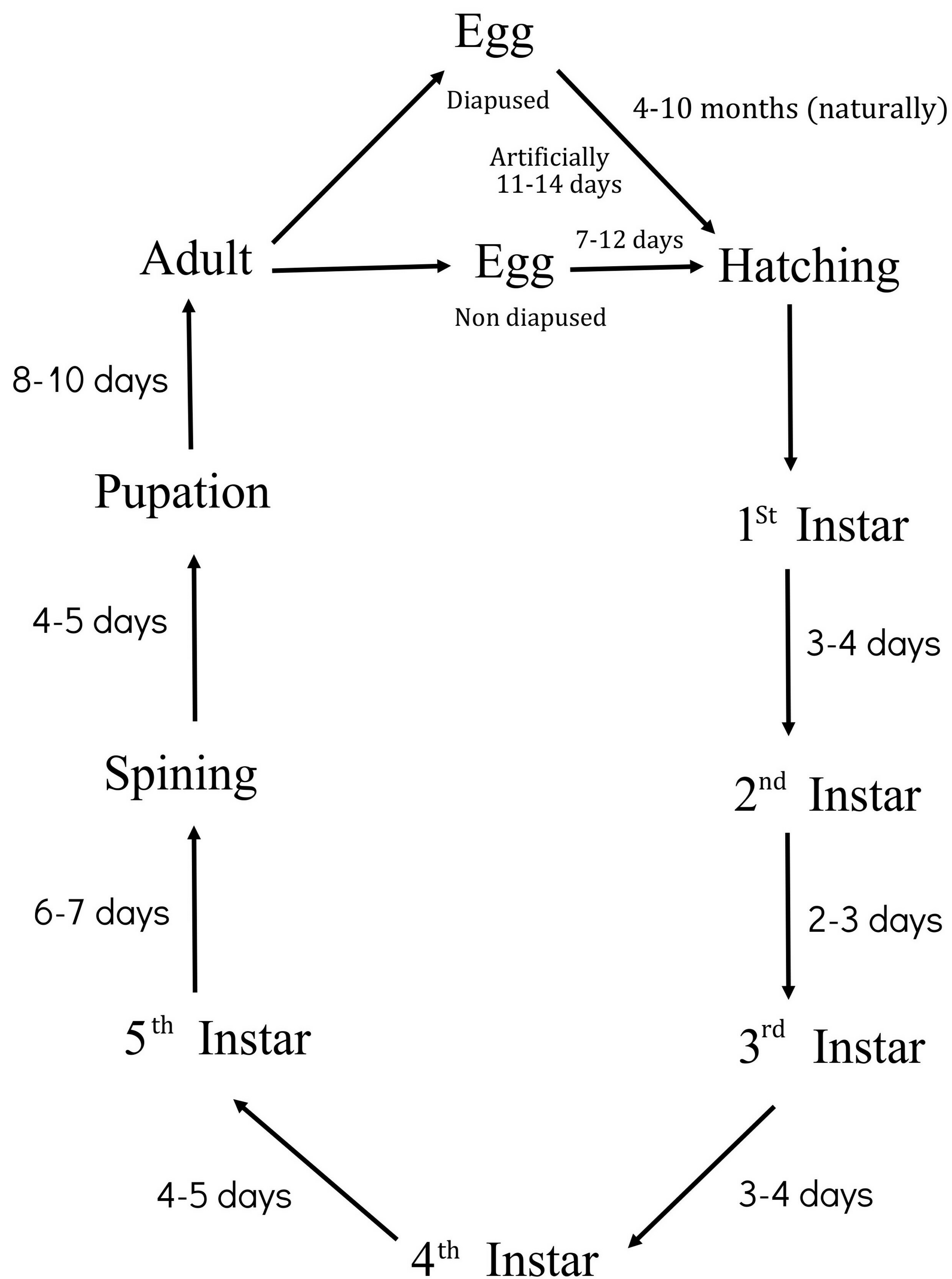


Fig: Life Cycle of Bombyx mori

Production Technology of Mulberry silkworm

Sericulture is an agrobased industry and it deals with mulberry culture and silkworm rearing. The rearing of silkworm involves the following steps-

1. Preparation of rearing silkworm.
2. Collection of race.
3. Mating.
4. Sterilization of eggs.
5. Egg incubation.
6. Larvae rearing.
7. Ripening, spinning and cocoon formation.
8. Cocoon harvesting.

1. Preparation of rearing silkworm

The rearing room and appliances used for rearing must be thoroughly cleaned and then disinfected with 2-4% formalin. Before disinfecting the rearing room, all crevices and holes should be filled.

2. Collection of race

Selection of sericulture board recommended race of diseased free silkworm cocoon.

3. Mating

Pairs adult just after emergence from cocoon by covering glass funnel and then remove male silkworm from female after mating. Immediately after copulation, female start to lay eggs. Provide egg card for egg laying. A female silkworm generally lays in an average 400 eggs (ranges 300-500).

4. Sterilization of eggs

Collect and then sterilize the one day old eggs with 2% formalin for 5 minutes. Afterword, wash in running water.

5. Egg incubation

Leave the eggs at 22-26⁰C temperature and 80-85% relative humidity in an incubator for incubation. In order to obtain uniform laying eggs at the blackhead stage are kept in black boxes on the day prior to hatching. In this way, the early maturing embryos are prevented from hatching and the late maturing embryo given time to develop and catch up with the early maturing ones. The next day, they are exposed certainly to diffused light so that the larvae has uniformly in response to the phototrophic stimulus. By this method, hatching of 90% and over can be obtained in one day.

6. Larvae rearing

I) Brushing: The process of transferring the newly hatched silkworm to rearing trays is called brushing. During brushing, the cards with the newly hatched silkworm are placed in the rearing trays and mulberry leaves cut into small square (0.5 cm²) are sprinkled over the egg cards. The hatched silkworm crawled on to the tender leaves and start feeding. Later the cards are removed and any worm still left on the cards are tapped on the rearing tray.

II) Feeding silkworm: Silkworms are feed to satisfy their apatite and to ensure their healthy and uniform growth. Care should be taken to feed the silkworm a sufficient quantity of high quality leaves. It is essential to supply chopped leaves to 1st and 2nd instar ones and whole leaves to the remaining instar. Usually four feeding a day at six hours interval in practiced. The quantity of the leaves required for rearing 50 laying or a box of 20,000 eggs at different instars is given below-

Age/Instar	Kg
1 st	1-2
2 nd	2-3
3 rd	15-20
4 th	35-50
5 th	300-325
Total	353-400

III) Bed cleaning: Removing the old mulberry leaves, faeces matter of silkworm, any dead or unhealthy silkworm etc. from the rearing bed is called bed cleaning. Accumulation of any such matter creates environmental condition detrimental to the health of silkworm. Usually the bed is cleaned once during the 1st instar, twice during the 2nd instar. i.e. just after first mould and again before setting for second mould and three times during the 3rd instar. i.e. just after second mould in the middle of the age and again just before setting for next mould. During 4th and 5th instar, the bed should be cleaned once a day in the morning.

For cleaning purpose, usually nets are used. The net is spread over the bed and one feeding is given before the nets are lifted and transferred to a fresh clean tray. The worms crawl through the meshes in the net and come up to feed on the leaves on the nets. If the worm are healthy, particularly all the worm will come up leaving the old leaves litter behind on the old trays which are cleaned later. The mesh size of the net used for the different instar are as follows-

Age/Instar	Mesh size
1 st and 2 nd	2 mm ²
3 rd	10 mm ²
4 th and 5 th	20 mm ²

IV) Spacing: Provision of adequate rearing seat space is of great importance of the vigorous and full growth of silkworm. As the worm grow in weight and size. The density in the rearing bed increases and condition of over crowding are faced. It is therefore, essential that the density of population in the rearing bed should be regulated. The spacing to be provided for different ages of silkworm is given below-

Age/Instar	No of larvae/ft ²
1 st	3000-4000
2 nd	2000-2500
3 rd	1000-1200
4 th	750-800
5 th	150-200
Spinning	40-50

V) Environmental condition: Since silkworm have been reared in different countries, they are influenced by nature wide delicate and very sensitive to environmental condition. Among the various environmental factors that influence the silkworm, the most important are-

- ◆ Temperature.
- ◆ Humidity.
- ◆ Photoperiod.
- ◆ Air.

Temperature and humidity: The temperature and humidity requirement for different instars are given below-

Age/Instar	Temperature ⁰ C	RH (%)
1 st	26-28	85
2 nd	26-28	85
3 rd	24-26	80
4 th	24-25	75
5 th	23-24	70
Spinning	25-26	60-70

Photoperiod: The usual photoperiod for silkworm larvae is 12 hours. However, the light should not be too bright.

Air: Silkworm required fresh air for their various physiological functions. So proper ventilation should be provided.

7. Ripening, spinning and cocoon formation

When the 5th instar larvae reach the maturity, it can be understand by showing their translucent body colour and raising their head upwards. Maturity occurs within 6-7 days after the last moult and in this time they completely cease feeding. Pick the larvae in time and place them in chandrika to facilitate undisturbed spinning cocoon formation.

8. Cocoon harvesting

Spinning takes about 3-4 days and cocoon needs to be harvested after full 5 days. 5 days are enough to transform a larvae to pupa formation and also cocoon gets dry enough to stand well against the risk of being crushed during transport. Therefore, the cocoon should be harvested after 5-6 days and then dry immediately in oven at 70-80⁰ C for 24 hours or in the sun.

Disease and Pest of silkworm

Disease	Insect pest
Pebrine: <i>Nosema bombycis</i> (Protozoan).	Uzi Fly: <i>Exorista bobmycis</i> .
Muscardine: <i>Beauveria bassiana</i> (Fungal).	Dermestid beetles: <i>Dermestes</i> spp.
Flacherie: <i>Bacillus bombysepticus</i> (Bacterial).	Earwigs: <i>Euborellia annulipes</i> .
Grasserie: Virus.	Mites.
Gattine: Virus.	Lizards, Rats, Squirrels, Birds etc.

Pebrine Disease

Symptoms

Egg stage

- Poor egg number.
- Reduction in size and weight.
- Lack of adherence of substratum, disuniform with more of dead and unfertilized eggs.
- Irregular hatching.

Larval stage

- Loss of appetite, retarded growth and disuniformity in size.
- Irregular moulting.
- Heavy mortality after 2nd moult if infected at egg stage.
- Larvae shrink in size and vomit gut juice.
- Dark brown or black spots may be seen sometimes on the body.

Pupal stage

- Pupa looks floppy and swollen.
- Irregular black spots on the body.
- Heavy mortality at pupal stage.

Moth stage

- Improper development of moth.
- Deformed wings and distorted antennae.
- Poor mating and egg laying.
- Scale of wings and abdominal area come off easily.

Control Measures

- ◆ Pebrine disease can be controlled by disinfecting the rearing room, equipments and rearing surroundings with 2% formalin.
- ◆ During rearing, unequal size worms and faecal matter should be microscopically examined for the presence of pebrine spores and if observed, larvae, cocoons and laying should be collected and burnt or buried.
- ◆ In the grainages, scientific methods of mother moth examination should be employed.
- ◆ Surface sterilization of the eggs with 2% formalin for 5 minutes.

Flacherie disease

Flacherie disease of silkworm is caused by bacteria or virus individually or in association. Depending on symptoms and cause they are called as bacterial flacherie disease, septicemia, sotto disease, etc. The disease may occur due to fluctuations in temperature, humidity and feeding poor quality mulberry leaves.

Symptoms

- Larvae become sluggish and loose appetite.
- Body shrinks, becomes soft and flaccid.
- Growth is retarded, becomes dull and vomits gut juice.
- Loose clasping power of prolegs.
- Body ferments, turn to different colour and oozes out foul smell.

Control measures

- ◆ Raise only healthy and strong silkworm races.
- ◆ Maintain proper temperature (22-25°C) and humidity (80-85%) during incubation of eggs.
- ◆ Attend thorough disinfection of rearing room, appliances and surroundings.

- ◆ Take strict hygienic measures during rearing.
- ◆ Isolate infected larvae from the healthy one immediately and destroy by burning or dumping deep in the soil.
- ◆ Provide quality leaves for feeding and maintain proper spacing and ventilation.
- ◆ Maintain proper temperature and humidity during rearing.
- ◆ Destroy sluggish, irregular moults and diseased worms.
- ◆ Do not allow late stage worms to feed on tender succulent leaves.
- ◆ Avoid injury to the worms, overcrowding of trays.
- ◆ Apply antibiotics like Streptomycin/Tetracyclin.

Grasserie disease

Grasserie is a viral disease in silkworm caused by Nuclear Polyhedrosis (NPV), Cytoplasmic polyhedrosis (CPV) and infectious flacherie. Nuclear polyhedrosis (NPV) is a major viral disease in silkworm. It is caused due to the presence of high temperature, high humidity and feeding of poor quality mulberry leaves. It is highly infectious.

Symptoms

In the early larval stage of infection, it is difficult to detect the disease. Microscopic examination of larvae may indicate the presence of polyhedral bodies. As the disease advances, the larvae lose appetite and skin becomes shiny before moulting. The inter-segment membrane becomes swollen. The haemolymph or body fluid becomes turbid white. Microscopic examination shows presence of large number of polyhedral bodies.

Control measures

- ◆ Rear the larvae under clean and hygienic condition.
- ◆ Thorough disinfection of rearing room, appliances and surroundings.
- ◆ Ensure proper disinfection of egg surface.
- ◆ Incubate eggs under hygienic conditions. Avoid touching with hands.
- ◆ Provide suitable and timely feed during rearing.
- ◆ Maintain proper spacing and adequate ventilation.
- ◆ Pick out diseased, weak and injured larvae and destroy them properly.
- ◆ Apply bed disinfectants as per recommended schedule and quantity.

Apiculture

Apiculture is the practice of keeping bees as well as the manufacturing of honey and bees wax.

Or, The raising and care of bees for commercial or agricultural purposes.

Species of honey bee

1. Indian bee: *Apis cerana indica*.
2. Rock bee: *Apis dorsata*.
3. European bee: *Apis mellifera*.
4. Little bee: *Apis florea*.
5. Dammer bee or stingless bee: *Melipona irridipennis*.

Honey bee Castes

The insect which are lived together is called social insect. They live in a colony. In a colony, have to maintain many rules and regulation based on division of labour. In a colony they are divided into several grades. These group are nothing but called caste. In honey bee, there are four caste-

- | | |
|-----------|-------------|
| 1) Queen. | 3) Worker. |
| 2) Drone. | 4) Soldier. |

1) Queen: Only one queen per colony, mother of colony, sexual female developed from fertilized eggs have sting used to kill rival queen. Large sized, 15-20 mm length, can lay eggs 1000-3000 per day. Can preserve more than two crore sperm. Mate once in life, longevity 3-5 years. No works, only reproduce.

2) Drone: Few in number per colony, bisexual male, developed from unfertilized eggs, no sting, medium large sized, 13-17 mm in length. Mate only once and then died, longevity 2-4 months, No work only feeding, Fly in air when bright light.

3) Worker: 5,000-50,000 per colony, sterile female developed from fertilized eggs, have sting used to defense, small size, 11-15 mm in length, longevity 3-6 months. All are worker.

Importance of Apiculture in Bangladesh

Bangladesh is an agricultural country. We have lot of flowers in the field, roads and even in the jungle which are full of nectar. If we take a little bit effort, we collected honey from these flower through which we can bring our economic solvency and even we can develop our national wealth.

However, through rearing honey bee, we can get two things-

A. Honey.

B. Wax.

A. Uses of honey

I) Use as food: About 80 chemicals constituents identified from honey which have high food value. Specially, these are children and older people plays a great role to them. Those are hard labour and player, honey is a great food. We can regain loss energy very quickly by using honey. Honey helps reduce constipation, bloating and gas. Substituting raw honey for white sugar can help in weight management.

II) Use as medicine

1. Consumption of raw honey can reduce risk of developing diabetes and help aid medication used to treat diabetes.
2. It can help reduce cholesterol and therefore decrease risk for coronary artery disease.
3. Raw honey makes brain function optimally by strengthening the heart and improving blood circulation.
4. If sourced locally, raw honey can help reduce seasonal allergies.
5. Consumption of honey promotes an increase is beneficial antioxidant agents, stimulates antibodies and combats harmful microbial activity.
6. Honey can help improve urinary tract infections due to its antibacterial properties.

III) Use as Cosmetics

1. It can be used as an affordable face cleanser to fight off acne, gentle on sensitive/all skin types.
2. A spoonful of raw honey mixed with olive oil and a squeeze of lemon can be used as a hydrating lotion.
3. Raw honey can cleanse and restore the health of hair and scalp.
4. Raw honey hair mask can help boost shine.

IV) Miscellaneous uses

1. Used in manufacturing different drinks.
2. Prepare bacterial media.
3. Poisonous bait.

B. Use of wax

Wax are used for various purpose. Some are given below-

1. Candle industry; where wax is the main ingredients.
 2. Pharmaceuticals; specially for making capsule.
 3. One of the best benefits of using beeswax on the skin is the moisturizing and the softening.
 4. Cosmetic industry; face cream, lipstick.
 5. Furniture industry.
 6. Used for Making electric insulator.
- C. Besides, honey bee plays a great role in pollination.

D. Unemployment problem: Many people can be solve their unemployment problem by involving themselves in apiculture.

Life Cycle

Caste	Egg period	Larval period	Pupal period	Total period	Adult longevity
Queen	3 days	5 days	7-8 days	15-16 days	5 years
Drone	3 days	4-5 days	11-12 days	18-20 days	2-4 months
Worker	3 days	5-7 days	13-14 days	21-24 days	3-6 months

Bee rearing technique/Production technology

Rearing of honey bees involves the following stage:

1. Preparation of bee box
2. Catching a swarm.
3. Hiving a swarm.
4. Colony inspection.

Site Requirements

- ◆ The selected site should be dry without dampness. High RH will affect bee flight and ripening of nectar.
- ◆ Clean natural or artificial source of water should be provided.
- ◆ Trees serve as wind belts in cool areas.
- ◆ Hives can be kept under shade of trees or artificial structures should be constructed to provide shade.
- ◆ Plants that yield pollen and nectar to bees are called bee pasturage and florage. Such plants should be plenty around the apiary site.

Honey Bee Farming Equipment

Thin & thick beekeeping brushes, SS knives, SS & iron hive tools of L shaped & curved shaped, Food graded plastic made queen cage, queen gate, hive gate, Honey Extractor, Smoker, Queen Excluder, Pollen Trap, Propolis Strip, Royal Jelly production & extraction Kit, Queen rearing kit, Bee venom Collector.

Management of bees for pollination

- It is recommended to place hives very near the field to save bee's energy.
- It is recommended to migrate colonies near the field at 10 % flowering.
- It is recommended to place colonies at 3 per ha for Italian bee and 5 per ha for Indian bees.
- The colonies should have at least 5 to 6 frame strength of bees and with sealed brood and young mated queen.
- Should allow sufficient space for pollen and honey storage.

Pests and Diseases

▲ Wax moths, Ants, Wasps, Wax beetles, Birds, Tracheal Mites, The parasitic mite Varroa destructor, Bee mites, Brood mite are the common pests found in honey bee farming.

▲ Nosema Disease, European foul-brood disease, American Foul Brood, Sac-brood disease (SBV), Thai sac brood virus (TSBV), Chalk brood disease and stone brood disease are the main diseases found in the honey bee farming.

Harvesting of Bee Products

Honey, Bees Wax, Royal Jelly, Bee Venom, Propolis & Pollen are the main bee products. Honey should be harvested at the end of a flowering season. In traditional or top-bar hives, the beekeeper should select a comb which contains ripe honey covered with a fine layer of white beeswax, usually those nearest the outside of the nest. Honey is extracted only from super combs using honey extractor equipment.